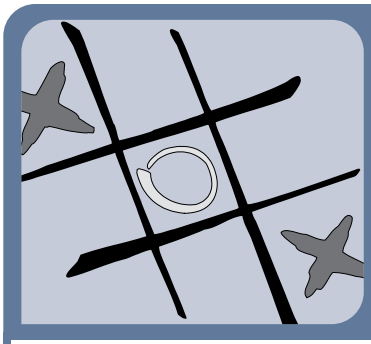


Potentially Kinetic

Through simple demonstrations, students are introduced to the presence of potential and kinetic energy in their lives and test their knowledge through a tic tac toe game.

Grade Level: (K–4) 5–8

Subject Areas: English Language Arts, Mathematics, Science

Setting: Classroom

Time:
Preparation: 15 minutes
Activity: Two 50-minute periods

Vocabulary: Chemical bond, Chemical potential energy, Elastic potential energy, Electrical potential energy, Gravitational potential energy, Kinetic energy, Light energy, Mechanical energy, Potential energy, Sound energy

Major Concept Areas:

- Definition of energy
- Natural laws that govern energy

Objectives

Students will be able to:

- define potential and kinetic energy; and
- identify forms of potential and kinetic energy.

Rationale

Understanding potential and kinetic energy helps students identify forms of energy.

Materials

- A rubber band
- 2 or 3 spoonfuls of baking soda in a clear glass or petri dish
- Vinegar
- A battery
- A flashlight
- A book or some other solid object
- Copies of ***Tic Tac Toe Energy Forms***, (optional; see activity sheet for materials needed)
- Find additional resources related to this activity on keepprogram.org > Curriculum & Resources

Background

Energy is classified into two main forms: kinetic energy and potential energy. Kinetic energy is defined as the energy of a moving object. A thrown football, a speeding automobile, or a rock falling from a cliff are examples of objects that have kinetic energy. Potential energy appears in many different forms, and is defined as the energy stored in matter due to its position or the arrangement of its parts.

Types of potential energy include gravitational potential energy, elastic potential energy, chemical potential energy, and electrical potential energy. When something is lifted or suspended in air, work is done on the object against the pull of gravity. This work is converted to a form of potential energy called gravitational potential energy. When the item succumbs to the force of gravity, it falls toward Earth, converting potential energy into kinetic energy.

A stretched rubber band has the potential to do work or change things. This form of energy is called elastic potential energy. It occurs when an

object (such as our skin or a rubber band) resists being stretched out of shape. The elastic potential energy in a rubber band can be used to do work. For example, toy airplanes fly when a rubber band untwists and spins a propeller. The elastic potential energy in the rubber band was converted to kinetic energy.

It would take millions of rubber bands to move a real airplane, so gasoline is used instead. But you don't stretch gasoline to make it work, you burn it. You could release energy by burning rubber bands, but it is not practical to do so (it would take too many rubber bands and make too much of a mess!). The chemical makeup of gasoline (the arrangement of its molecules) makes it a good fuel source.

All nonliving and living things, from automobiles to zebras, are made up of molecules. It takes energy to make these molecules and hold them together. The energy stored in molecules is called chemical potential energy. When the bonds that hold a molecule together are broken, energy is released. For example, the energy stored in gasoline is released by burning it. The airplane motor uses this released energy to turn a propeller. There are many examples of chemical potential energy being converted to kinetic energy to do work. The chemical energy in food is used by our bodies to move. In a lighted firecracker chemical energy is used to make a loud sound and to scatter pieces of the firecracker all over.

A battery has chemical potential energy along with electrical potential energy. When you turn on a device that is battery-operated, such as a flashlight or a toy, the electrical potential energy stored in the battery is converted into other forms of energy such as sound, mechanical motion, thermal energy, and light (see ***More about Batteries***). NOTE: For electrical appliances you plug in, the electrical potential energy is maintained by a spinning generator of a power plant, hydroelectric dam, or a wind generator. A solar cell stores electrical potential energy similar to a battery as long as the sun is shining on it.

Sound, mechanical motion, thermal energy, and light are not easily classified as kinetic and potential energy. Light is an example of electromagnetic radiation and has no mass, so it has neither kinetic nor potential energy. The remaining forms have qualities of both kinetic and potential energy. Sound is made up of vibrations (put your hand on a stereo speaker), thermal energy consists of moving molecules in air or in an object, and mechanical energy is the combination of kinetic and potential energy of a moving object. A pendulum has mechanical energy; it continually converts kinetic energy into gravitational potential energy and back into kinetic energy as it swings back and forth. A child also has mechanical energy when he moves about. When sitting

More About Batteries

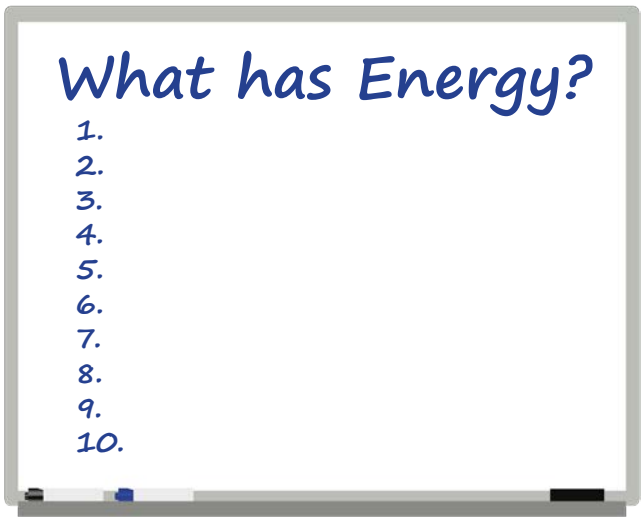
With the chemical potential energy in batteries, the chemicals are used to separate negative electric charges (electrons) from positive charges (protons), momentarily moving them. The separated positive and negative electric charges of a battery represent another form of potential energy called electrical potential energy. When the battery is connected to an electric circuit (when a device such as a flashlight is turned on), the electrons leave the negative terminal of the battery and move (flow) through the circuit to the positive terminal. In energy terms, electrical potential energy stored in the battery is converted into kinetic energy of moving electrons. The electrons' kinetic energy is then converted into another form, such as light with the flashlight or mechanical energy with a battery-operated fan.

the child has potential energy; but watch out, before you know it, it will suddenly be converted to kinetic energy!

Procedure

Orientation

Review the definition of energy with students ("the ability to do work or create change"). Challenge students to list, within 30 seconds, ten things that have energy. Write their responses on the board as they list them. After the list is complete (or time is up) ask students to examine the list. What is common among many of the items in the list



Chances are most of their examples display some form of movement. Circle items on the list that involve movement. Tell students that energy of motion is called kinetic energy. Write this term on the board.

There may be other items in the list that involve movement, but are not as apparent. These include sound and heat. These also have kinetic energy. NOTE: If students listed light, point out that a separate form of energy is called light energy. If students gave examples of potential energy (like a stationary object such as a statue), ask them to explain why they made this suggestion, writing their answers on the board. During the **Closure**, see if they can identify which form of potential energy their suggestions fall under.

Steps

1. Show students a rubber band, baking soda and vinegar, a battery, and a book or some other solid object. Ask students if these items have energy. Students may not see any evidence of energy (movement). Tell students that these items will help demonstrate the second main form of energy: potential energy. These items have the potential to do work or create change. Write the words "potential energy" across from the term "kinetic energy."

2. Request that a student come to the front of the room and stretch the rubber band and not let go (make sure the student is facing away from people). Now do students think there is energy in the rubber band? Discuss how the stretched rubber band, although it isn't moving, has the potential to move. The student can let go of the rubber band to prove it. This form of energy is called elastic potential energy.

3. Ask another student to come to the front of the room and pour a small amount of the vinegar onto the baking soda. Explain that the baking soda and vinegar are made of tiny particles called molecules, and energy is stored in the bonds that hold the molecules together. This form of energy is called chemical potential energy. Mixing the baking soda with the vinegar causes the bonds to break and the molecules to rearrange themselves. When they do, energy is released.

4. Show students a battery. Do they think it has energy? How can they prove it? Invite a student to put the batteries in a flashlight and show that the batteries make the flashlight work. Explain that a battery has electrical potential energy (see ***More about Batteries***).

5. Point out the book to students. Does it have energy? Students may comment that it must have chemical potential energy, which is true. Use the book to demonstrate another form of potential energy. Lift the book and place it precariously on a tall object, such as the top of a bookshelf. Do students think it has more or less potential energy now? Discuss the energy you used to lift the book. Would students feel comfortable standing under the book? Help students to understand that work was done against the force of gravity to lift it. Therefore the book gains gravitational potential energy.

Closure

Have students participate in the ***Tic Tac Toe Energy Forms*** game to assess their knowledge of forms of energy. You may want to play the first round as a class before separating students into groups. NOTE: The questions used in the game assume students know the definition

of energy, forms of energy, and how energy is used to do work or change things. Some questions are more directly related to concepts in this activity than others.

Assessment

Formative

- Are students able to define kinetic and potential energy?
- Can students identify forms of kinetic and potential energy and provide examples of each?

Summative

- The ***Tic Tac Toe Energy Forms*** game should provide insight into students' understanding of different forms of energy.
- Write the words "kinetic energy" and "potential energy" on the board and help students develop definitions for each. Have them summarize the forms of kinetic and potential energy (see **Background**). Ask them to provide examples of each.

Related KEEP Activities

This activity serves as a good introduction to forms of energy. In "Evidence of Energy" students gain an awareness of energy forms around them. To have students further investigate the forms of energy, see the activity "Exploring Heat" and K-5 Energy Sparks for Theme I: "Exploring Sound, Exploring Light Energy, and Exploring Movement." Chemical potential energy stored in energy sources is introduced in the activity "Where Does It Get Its Energy?" To help students understand that energy is stored in food, you may want to demonstrate how food can be burned (see "Roasted Vittles"). Electrical energy is introduced in K-5 Energy Sparks for Theme II: "Electricity in Our Lives" and the activity "Circuit Circus." The activity "Station Break" helps students recognize energy conversions in their lives, and is a good follow-up activity.

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Tic Tac Toe Energy Forms Answer Sheet

Answer Sheet Game 1

What would you have to do to a spring to give it elastic potential energy? ***Suggested answer:*** **Compress or stretch it.**	What do an inflated balloon, a stretched rubber band, and an extended bungee cord have in common? ***Suggested answer:*** **They all have elastic potential energy.**	What form of energy does a rolling ball have? ***Suggested answer:*** **Kinetic energy.**
How do you know a piece of wood has stored potential energy? ***Suggested answer:*** **It can burn.**	What must you do to a book found on a table to give it more gravitational potential energy? ***Suggested answer:*** **You must lift the book off the table against the force of gravity.**	What form of energy allows you to watch television? ***Suggested answer:*** **Electricity or electrical energy. (Light and sound are also acceptable answers.)**
Define kinetic energy. ***Suggested answer:*** **Energy of a moving object.**	What is the definition of energy? ***Suggested answer:*** **Ability to do work or create change.**	True or false: An apple has energy. Explain your answer. ***Suggested answer:*** **True. It has chemical potential or stored energy.**

Answer Sheet Game 2

What form of energy is demonstrated by twisting a rubber band? ***Suggested answer:*** **Elastic potential energy.**	What type of energy is present in a rain cloud? **Suggested answer:** **Gravitational potential energy.**	What form of energy is present in an unlit candle? ***Suggested answer:*** **Chemical potential energy.**
What do batteries, bananas, and baking soda mixed with vinegar have in common? ***Suggested answer:*** **They all have chemical potential energy.**	What form of energy is involved in writing? ***Suggested answer:*** **Mechanical energy, kinetic energy.**	What kind of potential energy does a battery contain? ***Suggested answer:*** **Electrical potential energy, chemical potential energy.**
What energy form enables you to listen to your favorite music? ***Suggested answer:*** **Sound, electricity.**	Give three examples of sound energy. ***Suggested answer:*** **A bell ringing, the radio blasting, my voice.**	Name three forms of potential energy. ***Suggested answer:*** **Chemical, elastic, gravitational.**

Answer Sheet Game 3

Jumping on a diving board temporarily gives it what kind of energy? ***Suggested answer:*** **Elastic potential energy.**	Use your pencil to demonstrate gravitational potential energy. ***Suggested answer:*** **Pick the pencil up off the table.**	What form of potential energy is present in a bouncing ball? (There are two, but you need to list only one.) ***Suggested answer:*** **Gravitational (when it is held above the floor) and elastic (when it hits the floor).**
Name three examples of kinetic energy. ***Suggested answer:*** **Moving car, thrown ball, falling coin.**	What type of energy is present in food? ***Suggested answer:*** **Chemical potential energy.**	What form of energy is demonstrated by water in a dam? ***Suggested answer:*** **Gravitational potential energy**
Which has more gravitational potential energy, a rock held three feet above the ground or the same rock held three feet higher? ***Suggested answer:*** **The rock held six feet above the ground.**	Define potential energy. ***Suggested answer:*** **The energy stored in matter due to its position or arrangement of its parts.**	How was chemical potential energy released when the baking soda was mixed with the vinegar? ***Suggested answer:*** ***The baking soda reacted to the vinegar causing molecules to break apart, rearrange themselves and release chemical potential energy.***

Tic Tac Toe Energy Forms

Instructions

Work in groups of three. One of you will be the judge and the other two the players. There are three games, so switch off for each game so each of you gets to be the judge once. Your teacher will supply the judge with the answer sheet.

One player gets Os and the other Xs. Decide who goes first. The first player places an X or O in a cell and tries to answer the appropriate question for that game. The player has two minutes to respond. If answered correctly, the X or O stays in place and it's the other player's turn. If answered incorrectly, the player removes the X or O and it's the other player's turn. If there is a question that neither player can answer, then a blank square of paper is put over that cell. This means that cell cannot be used during the rest of the game. Continue the game in this fashion until someone wins (three Xs or Os in a row vertically, horizontally, or diagonally). If the game is a draw, the person who correctly answered the most questions wins. The judge should share correct responses to all unanswered questions after the game is over.

Materials

- Xs and Os
- Blank pieces of paper

Tic Tac Toe Energy Forms

Game 1 Questions

What would you have to do to a spring to give it elastic potential energy?	What do an inflated balloon, a stretched rubber band, and an extended bungee cord have in common?	What form of energy does a rolling ball have?
How do you know a piece of wood has stored potential energy?	What must you do to a book found on a table to give it more gravitational potential energy?	What form of energy allows you to watch television?
Define kinetic energy.	What is the definition of energy?	True or false: An apple has energy. Explain your answer.

Tic Tac Toe Energy Forms

Game 2 Questions

What form of energy is demonstrated by twisting a rubber band?	What type of energy is present in a rain cloud?	What form of energy is present in an unlit candle?
What do batteries, bananas, and baking soda mixed with vinegar have in common?	What form of energy is involved in writing?	What kind of potential energy does a battery contain?
What energy form enables you to listen to your favorite music?	Give three examples of sound energy.	Name three forms of potential energy.

Tic Tac Toe Energy Forms

Game 3 Questions

Jumping on a diving board temporarily gives it what kind of energy?	Use your pencil to demonstrate gravitational potential energy.	What form of potential energy is present in a bouncing ball? (There are two, but you need to list only one.)
Name three examples of kinetic energy.	What type of energy is present in food?	What form of energy is demonstrated by water in a dam?
Which has more gravitational potential energy, a rock held three feet above the ground or the same rock held three feet higher?	Define potential energy.	How was chemical potential energy released when the baking soda was mixed with the vinegar?